

ULYSSES

SCE 1-S DOPPLER DATA, CONJ. C1

90-090B-10C

THIS DATA SET CONSISTS OF 1 4MM TAPE WHICH IS THE D NUMBER WRITTEN IN LOW DENSITY, BINARY, VAAX LABELED. THE D AND C NUMBERS ARE BELOW ALONG WITH TAPE NAME, TIME SPAN AND NUMBER OF FILES. ALSO INCLUDED IN THE CATALOG ARE VARIOUS SUPPORT DOCUMENTS.

DD#	DC#	FILES	TIMESPAN
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DD109087	DC033071	195	08/06/91 - 09/05/91

Ulysses Solar Corona Experiment (SCE)

The Ulysses dual-frequency radio subsystem was utilized by the Ulysses Solar Corona Experiment (SCE) to measure the electron content ('column density') and its variations during the first solar conjunction (C1) of the Ulysses mission in the summer of 1991 as well as the fourth solar conjunction (C4) in the winter of 1995. In the nominal mode for radio-sounding observations [BIRDETAL1992A], both downlinks (S-band: $f_s = 2.3$ GHz; X-band: $f_x = 8.4$ GHz) are phase coherent with the uplink (S-band: $f_u = 2.1$ GHz). The dual-frequency radio-sounding technique exploits the dispersive nature of ionized media on the propagation of the two downlinks. The tiny Doppler shift due to plasma moving in and out of the ray path is greater at S-band than at the higher frequency X-band. Similarly, because the group velocity of waves propagating in ionized media is smaller for lower frequencies, the round-trip time of propagation for coded range signals between the spacecraft and the ground station will be longer at S-band than at X-band.

SCE Data Types

The SCE data are obtained from the Radio Science Support group at JPL [ASMAR&RENZETTI1993; ASMARETAL1995]. There are basically two types of data: ranging and Doppler (Frequency), recorded at the tracking sites of the NASA Deep Space Network (DSN) as a function of UT Ground Received Time [DSN810-5]. The raw data are delivered in special binary files called ATDFs (Archival Tracking Data Files), containing ranging and Doppler data from the standard DSN tracking receivers. There are high time resolution Doppler data from special radio science receivers (so-called 'open loop' data) as well. These are in files called ODRs (Original Data Records).

ATDFs are files of radiometric data produced by the Network Operations Control Center (NOCC) Navigation Subsystem (NAV). They are derived from Intermediate Data Records by NAV and contain all radiometric measurements received from the DSN station including signal levels ('AGC' = automatic gain control in dBm), antenna pointing angles, frequency (often referred to simply as 'Doppler'), range, and residuals. Doppler data are often used to infer spacecraft radial motion relative to the tracking antenna. Data values in ATDFs are reported at rates no higher than 10 per second. For the Ulysses solar conjunction C1 the received frequencies at S-Band and X-band were recorded at a nominal sample time of one per second. Ranging data were recorded nominally at intervals of ca. 10 minutes. Each ATDF data record contains 117 parameters, stored in records of 288 bytes. The ATDF is described in section TRK-2-25 of the JPL Document 820-13 [DSN820-13].

SCE Data Recording Opportunities

The ranging data from the ATDFs have been analyzed for the solar conjunction C1 and a number of publications describe the results [PAETZOLDETAL1992; BIRDETAL1994; WOOETAL1995A; WOOETAL1995B; WOO1996; PAETZOLDETAL1997]. Ranging results from the geometrically unique fourth Ulysses solar conjunction (C4) are also available [PAETZOLDETAL1995; BIRDETAL1996; WOO&HABBAL1997; PAETZOLD&BIRD1998; WOO&HABBAL1998]. Coronal velocities as a function of solar distance were derived from the C1 Doppler data using a correlation technique between uplink and downlink [WOHLMUTHETAL1997] and between two simultaneously tracking ground stations [JANARDHANETAL1999]. Differences in the spectral characteristics of electron density fluctuations observed

in coronal holes vs. corona streamers were reported from analyses of the C4 Doppler data [PAETZOLDETAL1996; KARLETAL1997]. The Ulysses radio subsystem was utilized during the Jupiter encounter to measure the columnar electron density of the Io Plasma Torus [BIRDETAL1992B; BIRDETAL1993]. These data, together with all Ulysses results from the Jupiter encounter, are archived at the Planetary Data System (PDS).

SCE Ranging Data Processing

Data files have been generated which contain the ranging data at an advanced stage of processing. After stripping the ranging data from the ATDFs and weeding out obviously bad data, tables of the measured data plus physically relevant quantities were produced for the archive as function of time.

Ranging data during the Ulysses solar conjunctions C1 (7 August to 5 September 1991) and C4 (23 February to 14 March 1995) have been provided to this archive in the RANGE_C1.TXT and RANGE_C4.TXT files.

As an example, the first few lines of RANGE_C1.TXT are as follows:

year	mo	dd	hh:mm:ss	set	no	dss	difrng	econt
1991-	8-	7T	1:11:23.712Z	1	1	43	557	2227
1991-	8-	7T	1:21:24.192Z	1	2	43	555	2219
1991-	8-	7T	1:31:24.672Z	1	3	43	567	2267
1991-	8-	7T	1:41:24.288Z	1	4	43	575	2299
1991-	8-	7T	1:51:23.904Z	1	5	43	578	2311
1991-	8-	7T	2: 1:23.520Z	1	6	43	574	2295
1991-	8-	7T	2:11:24.000Z	1	7	43	567	2267
1991-	8-	7T	2:21:23.616Z	1	8	43	575	2299
1991-	8-	7T	2:31:23.232Z	1	9	43	584	2335
1991-	8-	7T	2:41:23.712Z	1	10	43	570	2279
1991-	8-	7T	2:51:24.192Z	1	11	43	572	2287
1991-	8-	7T	3: 1:24.672Z	1	12	43	582	2327
1991-	8-	7T	3:11:24.288Z	1	13	43	591	2363
1991-	8-	7T	3:31:23.520Z	1	14	43	596	2383
1991-	8-	7T	3:41:24.000Z	1	15	43	588	2351

where:

year : 1991
 mo : month of year
 dd : day of month
 hh:mm:ss : hours, minutes seconds (UT, ground received)
 set : running no. for each DSN tracking pass during C1, C4, resp.
 no : running no. for range measurement within each tracking pass
 dss : DSN station number
 difrng : differential range delay in 'range units' (RU) [DSN810-5]
 econt : electron content in 'hexems' [BIRDETAL1992A; BIRDETAL1994]

note: difrng (RU) and econt (hexems) are given to the nearest respective unit. The estimated accuracy of a differential range measurement is of the order of 50 range units.

The following table gives information about the size and coverage of the Ulysses SCE ranging data set from the two solar conjunctions:

Conj	Year	start mo:dd:hh:mm	stop mo:dd:hh:mm	ascii size (kB)	gzip size (kB)
C1	1991	08:07:01:11	09:05:17:55	88	20
C4	1995	02:23:05:06	03:14:14:06	145	33

SCE Doppler Data Processing

Data files have been generated from the ATDFs which contain the quantities of interest for analysis of the Ulysses downlink frequencies. The data set for the first solar conjunction C1 in 1991 from DOY 218-248 (6 August to 5 September) consists of the following files :

DOP91218.063.gz	DOP91227.012.gz	DOP91235.043.gz	DOP91242.014.gz
DOP91219.043.gz	DOP91227.043.gz	DOP91235.063.gz	DOP91242.043.gz
DOP91219.061.gz	DOP91227.063.gz	DOP91236.014.gz	DOP91243.014.gz
DOP91220.043.gz	DOP91228.014.gz	DOP91236.043.gz	DOP91243.063.gz
DOP91221.014.gz	DOP91228.063.gz	DOP91237.014.gz	DOP91244.014.gz
DOP91221.043.gz	DOP91229.014.gz	DOP91237.063.gz	DOP91244.063.gz
DOP91221.143.gz	DOP91229.043.gz	DOP91238.014.gz	DOP91245.014.gz
DOP91222.014.gz	DOP91229.063.gz	DOP91238.043.gz	DOP91245.063.gz
DOP91222.043.gz	DOP91230.014.gz	DOP91238.063.gz	DOP91246.014.gz
DOP91223.014.gz	DOP91230.063.gz	DOP91239.014.gz	DOP91246.043.gz
DOP91223.043.gz	DOP91231.014.gz	DOP91239.043.gz	DOP91247.014.gz
DOP91224.014.gz	DOP91231.063.gz	DOP91239.063.gz	DOP91248.014.gz
DOP91224.063.gz	DOP91232.014.gz	DOP91240.014.gz	DOP91248.043.gz
DOP91225.014.gz	DOP91233.014.gz	DOP91240.063.gz	datalist.c1
DOP91225.063.gz	DOP91234.014.gz	DOP91241.012.gz	
DOP91226.014.gz	DOP91234.043.gz	DOP91241.043.gz	
DOP91226.063.gz	DOP91234.063.gz	DOP91241.063.gz	

The data set for the fourth solar conjunction C4 in 1995 from DOY 53-73 (22 February to 14 March) consists of the following files :

DOP95053.042.gz	DOP95057.042.gz	DOP95063.042.gz	DOP95069.012.gz
DOP95054.012.gz	DOP95057.061.gz	DOP95063.061.gz	DOP95069.042.gz
DOP95054.061.gz	DOP95057.142.gz	DOP95064.061.gz	DOP95069.061.gz
DOP95054.161.gz	DOP95057.161.gz	DOP95065.042.gz	DOP95070.042.gz
DOP95055.042.gz	DOP95058.061.gz	DOP95065.061.gz	DOP95070.061.gz
DOP95055.061.gz	DOP95059.042.gz	DOP95065.142.gz	DOP95071.012.gz
DOP95055.142.gz	DOP95059.061.gz	DOP95066.042.gz	DOP95071.042.gz
DOP95055.161.gz	DOP95060.042.gz	DOP95066.061.gz	DOP95071.061.gz
DOP95056.012.gz	DOP95060.061.gz	DOP95067.012.gz	DOP95072.042.gz
DOP95056.042.gz	DOP95061.012.gz	DOP95067.042.gz	DOP95072.061.gz
DOP95056.061.gz	DOP95061.042.gz	DOP95067.061.gz	DOP95073.042.gz
DOP95056.161.gz	DOP95062.042.gz	DOP95068.012.gz	DOP95073.061.gz
DOP95057.012.gz	DOP95062.061.gz	DOP95068.042.gz	datalist_c4.txt

The "gz" suffix means that these files have been compressed with the UNIX gzip utility. They can be expanded to ascii tables with the analog gunzip utility. Each file contains dual-frequency Doppler data at a sample rate of 1 point per second from each tracking pass. The filename provides the day-of-year (doy) and ground tracking station (dss) according to the scheme "DOPyydoy.dss", where the year number is yy = 91 (C1) or 95 (C4). The doy given to each file applies to the start of the data recording. The deep space stations of the NASA Deep Space Network (DSN) used for SCE are:

DSS 12 : Goldstone	34-m
DSS 14 : Goldstone	70-m
DSS 42 : Canberra	34-m
DSS 43 : Canberra	70-m
DSS 61 : Madrid	34-m
DSS 63 : Madrid	70-m

Some tracking passes, especially at the Canberra stations, continue on into the next doy. Normally, a "0" precedes the dss number. The few cases with a "1" rather than "0" are a separate tracking pass at the same dss later on the same doy. The files "datalist_c1.txt" and "datalist_c4.txt" contain listings of each tracking pass with such information as date, ATDF number, start and end times of pass, start and end times of data recording, pass duration, station overlaps, etc.

Each file contains 15 columns per data point defined as follows:

column	explanation
1-4	time tag (UT, ground received)
1	DOY in 1991 (C1) or 1995 (C4)
2	HH
3	MM
4	SS
5	DSS
6	uplink frequency [Hz]
7-10	S-band receiver parameters
7	agc [dBm]
8	downlink frequency [Hz]
9	downlink frequency residual [Hz]
10	total slipped cycles during count
11-14	X-band receiver parameters
11	agc [dBm]
12	downlink frequency [Hz]
13	downlink frequency residual [Hz]
14	total slipped cycles during count
15	differential Doppler from Counts

A more detailed explanation of the parameters is given in section CRK-2-15 of the JPL Document 820-13 [DSN820-13].

The total volume of validated SCE Doppler data in the archive is given for both conjunctions in the following table.

conjunction	# passes	# hours	# hours	total MB	total MB
		total	overlap	(ASCII)	(binary compressed)
C1					
ingress	30	169.4	12.2	74.0	14.9
egress	34	201.0	14.4	87.8	17.5
total	64	370.4	26.6	161.8	32.4
C4					
ingress	27	188.2	5.1	73.8	14.8
egress	24	194.0	7.5	76.0	15.2
total	51	382.2	12.6	149.8	30.0
<hr/>					
C1+C4	115	752.6	39.2	311.6	62.4

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Ulysses Dual-frequency Doppler Data
 Superior Conjunction C1
 6 August 1991 (DOY 218) --- 5 September 1991 (DOY 248)

TO	DOY	Date	ATDF	DSS	File No	DOP91..	Pass Start	Data Start	Data Stop	Pass Stop	Total Hours	Comments
1	218	A06	30	63	218.063	14:30	14:30	18:54	18:59	4.40	S-band ON	
2	219	A07	30	43	219.043	23:26#	01:10	04:39	04:45	3.48		
3	219	A07	30	61	219.061	07:40	09:25	15:54	15:54	6.48		
4	220	A08	31	43	220.043	00:29	02:06	07:12	07:12	5.10		
5	221	A09	31	43	221.043	22:35#	00:16	07:20	07:20	7.07		
6	221	A09	32	14	221.014	17:45	19:37	23:00	23:01	3.38		
7	221	A09	32	43	221.143	22:05	22:22	05:46*	05:47*	7.40	0.63 olap	
8	222	A10	33	14	222.014	18:00	19:52	01:30*	01:31*	5.13		
9	222	A10	33	43	222.043	23:00	23:30	07:01*	07:02*	7.52	2.02 olap	
10	223	A11	34	14	223.014	18:50	20:42	01:30*	01:43*	4.80		
11	223	A11	34	43	223.043	23:27	23:27	07:06*	07:06*	7.65	2.05 olap	
12	224	A12	35	63	224.063	09:40	11:22	17:45	17:45	6.38		
13	224	A12	35	14	224.014	15:45	16:03	21:15	21:16	5.20	1.70 olap	
14	225	A13	36	63	225.063	12:00	13:38	17:15	18:50	3.62		
15	225	A13	36	14	225.014	16:36	17:59	22:54	23:11	4.92		
16	226	A14	36/37	63	226.063	11:42	13:39	18:00	18:01	4.35		
17	226	A14	37	14	226.014	16:45	17:00	24:00	24:00	7:00	1.00 olap	
18	227	A15	37/38	63	227.063	10:06	12:42	18:51	18:51	6.15		
19	227	A15	38	12	227.012	18:05	19:56	22:20	22:20	2.40		
20	227	A15	38	43	227.043	21:44	22:42	06:11*	06:11*	7.48		
21	228	A16	39	63	228.063	11:35	14:35	18:45	18:46	4.17		
22	228	A16	39	14	228.014	16:30	16:45	01:20*	01:24*	8.58	2.02 olap	
23	229	A17	40	63	229.063	12:11	13:41	17:52	17:52	4.15		
24	229	A17	40	14	229.014	17:05	17:20	01:15*	01:16*	7.92	0.53 olap	
25	229	A17	40/41	43	229.043	23:07	23:29	04:01*	04:04*	4.53	1.77 olap	
26	230	A18	41/42	63	230.063	06:10	08:12	17:00	17:00	8.80		
27	230	A18	42	14	230.014	16:20	16:33	20:00	20:00	3.45	0.45 olap	
28	231	A19	42	63	231.063	10:58	13:08	18:02	18:33	4.87		
29	231	A19	42/43	14	231.014	16:25	18:23	22:39	22:46	4.27		
30	232	A20	43	63	232.063	11:55	-----	-----	16:47	0:00	reject data	
31	232	A20	43/44	14	232.014	13:45	16:37	01:24*	01:33*	8.78		
								subtotals:	169.43	12.17	(9)	

***** Conjunction C1 *****

32	233	A21	44	63	233.063	11:44	-----	-----	16:50	0:00	reject data
33	233	A21	44	14	233.014	14:40	17:57	23:32	23:35	5.58	
34	234	A22	44	63	234.063	12:04	14:42	18:00	18:01	3.30	poor data
35	234	A22	45	14	234.014	17:25	19:08	01:55*	01:55*	6.78	
36	234	A22	45	43	234.043	21:34	23:08	05:24*	05:30*	6.27	2.78 olap
37	235	A23	46	63	235.063	11:45	14:42	18:26	18:27	3.73	
38	235	A24	46	43	235.043	21:18	23:04	05:30*	05:30*	6.43	
39	236	A24	46	63	236.063	11:56	-----	-----	16:30	0.00	reject data
40	236	A24	46/47	14	236.014	15:55	16:10	23:05	23:07	6.92	
41	236	A24	47/48	43	236.043	21:15	21:19	06:19*	06:30*	9.00	1.80 olap
42	237	A25	48/49	63	237.063	06:05	06:05	18:21	18:21	12.27	0.23 olap
43	237	A25	49	14	237.014	16:15	16:15	21:46	21:46	5.52	
44	238	A26	49/50	63	238.063	05:50	07:40	18:15	18:16	10.58	
45	238	A26	50/51	14	238.014	17:40	17:40	01:30*	01:32*	7.83	0.58 olap
46	238	A26	51	43	238.043	23:03	23:03	05:45*	05:45*	6.70	2.45 olap
47	239	A27	51	63	239.063	11:35	13:25	16:45	16:45	3.33	
48	239	A27	51/52	14	239.014	16:05	18:03	23:46	23:49	5.72	
49	239	A27	52	43	239.043	21:05	21:11	23:30	23:30	2.32	2.32 olap

50	240	A28	52	63	240.063	11:40	13:25	18:10	18:10	4.75
51	240	A28	53	14	240.014	14:35	19:22	00:26*	00:31*	5.07
52	241	A29	53	63	241.063	11:40	13:25	18:05	18:05	4.67
53	241	A29	53	12	241.012	15:20	19:22	23:05	23:06	3.72
54	241	A29	54	43	241.043	21:00	22:43	05:05*	05:05*	6.37 olap
55	242	A30	54	14	242.014	15:50	17:45	22:40	22:40	4.92
56	242	A30	54/55	43	242.043	21:01	22:44	05:05*	05:06*	6.35
57	243	A31	55/56	63	243.063	11:33	13:25	18:00	18:00	4.58
58	243	A31	56	14	243.014	16:05	16:05	23:46	23:46	7.68 1.92 olap
59	244	S01	56/57	63	244.063	11:08	13:25	17:55	17:57	4.50
60	244	S01	56/57	14	244.014	15:40	17:29	23:53	23:55	6.40 0.43 olap
61	245	S02	57	63	245.063	13:06	15:08	17:55	17:55	2.78
62	245	S02	57/58	14	245.014	15:50	17:34	01:15*	01:35*	7.68 0.35 olap
63	246	S03	58/59	14	246.014	17:16	18:55	00:20*	00:21*	5.42
64	246	S03	58/59	43	246.043	21:17	23:09	06:11*	06:14*	7.22 1.18 olap
65	247	S04	59	14	247.014	16:45	18:30	00:18*	00:18*	6.80
66	248	S04	60	43	248.043	00:24	00:24	05:16	05:16	4.87
67	248	S05	60	14	248.014	13:00	13:10	18:06	22:50	4.93

= previous day; * = next day 64 pass (20 olap) total: 370.42 26.58

Directory MKB300: []

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DOP91225_063.;1	2-MAR-1999 00:00:00.00
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DOP91234_014.;1	2-MAR-1999 00:00:00.00
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DOP91234_063.;1	2-MAR-1999 00:00:00.00
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DOP91236_014.;1	2-MAR-1999 00:00:00.00
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DOP91241_043.;1	2-MAR-1999 00:00:00.00
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)P91242_043.;1	2-MAR-1999 00:00:00.00
)P91243_014.;1	2-MAR-1999 00:00:00.00
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DOP91245_014.;1	2-MAR-1999 00:00:00.00
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P91247_014.;1	2-MAR-1999 00:00:00.00
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DOP91248_043.;1	2-MAR-1999 00:00:00.00
SCE_DS.TXT;1	2-MAR-1999 00:00:00.00

Total of 65 files.

ULYSSES

SCE 1-S DOPPLER DATA, CONJ. C4

90-090B-10D

THIS DATA SET CONSISTS OF 1 4MM TAPE WHICH IS THE D NUMBER WRITTEN IN LOW DENSITY, BINARY, VAAX LABELED. THE D AND C NUMBERS ARE BELOW ALONG WITH TAPE NAME, TIME SPAN AND NUMBER OF FILES. ALSO INCLUDED IN THE CATALOG ARE VARIOUS SUPPORT DOCUMENTS.

DD#	DC#	FILES	TIMESPAN
-----	-----	-----	-----
DD109088	DC033072	156	02/22/95 - 03/14/95

Ulysses Solar Corona Experiment (SCE)

The Ulysses dual-frequency radio subsystem was utilized by the Ulysses Solar Corona Experiment (SCE) to measure the electron content ('column density') and its variations during the first solar conjunction (C1) of the Ulysses mission in the summer of 1991 as well as the fourth solar conjunction (C4) in the winter of 1995. In the nominal mode for radio-sounding observations [BIRDETAL1992A], both downlinks (S-band: $f_s = 2.3$ GHz; X-band: $f_x = 8.4$ GHz) are phase coherent with the uplink (S-band: $f_u = 2.1$ GHz). The dual-frequency radio-sounding technique exploits the dispersive nature of ionized media on the propagation of the two downlinks. The tiny Doppler shift due to plasma moving in and out of the ray path is greater at S-band than at the higher frequency X-band. Similarly, because the group velocity of waves propagating in ionized media is smaller for lower frequencies, the round-trip time of propagation for coded range signals between the spacecraft and the ground station will be longer at S-band than at X-band.

SCE Data Types

The SCE data are obtained from the Radio Science Support group at JPL [ASMAR&RENZETTI1993; ASMARETAL1995]. There are basically two types of data: ranging and Doppler (Frequency), recorded at the tracking sites of the NASA Deep Space Network (DSN) as a function of UT Ground Received Time [DSN810-5]. The raw data are delivered in special binary files called ATDFs (Archival Tracking Data Files), containing ranging and Doppler data from the standard DSN tracking receivers. There are high time resolution Doppler data from special radio science receivers (so-called 'open loop' data) as well. These are in files called ODRs (Original Data Records).

ATDFs are files of radiometric data produced by the Network Operations Control Center (NOCC) Navigation Subsystem (NAV). They are derived from Intermediate Data Records by NAV and contain all radiometric measurements received from the DSN station including signal levels ('AGC' = automatic gain control in dBm), antenna pointing angles, frequency (often referred to simply as 'Doppler'), range, and residuals. Doppler data are often used to infer spacecraft radial motion relative to the tracking antenna. Data values in ATDFs are reported at rates no higher than 10 per second. For the Ulysses solar conjunction C1 the received frequencies at S-Band and X-band were recorded at a nominal sample time of one per second. Ranging data were recorded nominally at intervals of ca. 10 minutes. Each ATDF data record contains 117 parameters, stored in records of 288 bytes. The ATDF is described in section TRK-2-25 of the JPL Document 820-13 [DSN820-13].

SCE Data Recording Opportunities

The ranging data from the ATDFs have been analyzed for the solar conjunction C1 and a number of publications describe the results [PAETZOLDETAL1992; BIRDETAL1994; WOOETAL1995A; WOOETAL1995B; WOO1996; PAETZOLDETAL1997]. Ranging results from the geometrically unique fourth Ulysses solar conjunction (C4) are also available [PAETZOLDETAL1995; BIRDETAL1996; WOO&HABBAL1997; PAETZOLD&BIRD1998; WOO&HABBAL1998]. Coronal velocities as a function of solar distance were derived from the C1 Doppler data using a correlation technique between uplink and downlink [WOHLMUTHETAL1997] and between two simultaneously tracking ground stations [JANARDHANETAL1999]. Differences in the spectral characteristics of electron density fluctuations observed

in coronal holes vs. corona streamers were reported from analyses of the C4 Doppler data [PAETZOLDETAL1996; KARLETAL1997]. The Ulysses radio subsystem was utilized during the Jupiter encounter to measure the columnar electron density of the Io Plasma Torus [BIRDETAL1992B; BIRDETAL1993]. These data, together with all Ulysses results from the Jupiter encounter, are archived at the Planetary Data System (PDS).

SCE Ranging Data Processing

Data files have been generated which contain the ranging data at an advanced stage of processing. After stripping the ranging data from the ATDFs and weeding out obviously bad data, tables of the measured data plus physically relevant quantities were produced for the archive as function of time.

Ranging data during the Ulysses solar conjunctions C1 (7 August to 5 September 1991) and C4 (23 February to 14 March 1995) have been provided to this archive in the RANGE_C1.TXT and RANGE_C4.TXT files. As an example, the first few lines of RANGE_C1.TXT are as follows:

year	mo	dd	hh:mm:ss	set	no	dss	difrng	econt
1991-	8-	7T	1:11:23.712Z	1	1	43	557	2227
1991-	8-	7T	1:21:24.192Z	1	2	43	555	2219
1991-	8-	7T	1:31:24.672Z	1	3	43	567	2267
1991-	8-	7T	1:41:24.288Z	1	4	43	575	2299
1991-	8-	7T	1:51:23.904Z	1	5	43	578	2311
1991-	8-	7T	2: 1:23.520Z	1	6	43	574	2295
1991-	8-	7T	2:11:24.000Z	1	7	43	567	2267
1991-	8-	7T	2:21:23.616Z	1	8	43	575	2299
1991-	8-	7T	2:31:23.232Z	1	9	43	584	2335
1991-	8-	7T	2:41:23.712Z	1	10	43	570	2279
1991-	8-	7T	2:51:24.192Z	1	11	43	572	2287
1991-	8-	7T	3: 1:24.672Z	1	12	43	582	2327
1991-	8-	7T	3:11:24.288Z	1	13	43	591	2363
1991-	8-	7T	3:31:23.520Z	1	14	43	596	2383
1991-	8-	7T	3:41:24.000Z	1	15	43	588	2351

where:

year : 1991
 mo : month of year
 dd : day of month
 hh:mm:ss : hours, minutes seconds (UT, ground received)
 set : running no. for each DSN tracking pass during C1, C4, resp.
 no : running no. for range measurement within each tracking pass
 dss : DSN station number
 difrng : differential range delay in 'range units' (RU) [DSN810-5]
 econt : electron content in 'hexems' [BIRDETAL1992A; BIRDETAL1994]

note: difrng (RU) and econt (hexems) are given to the nearest respective unit. The estimated accuracy of a differential range measurement is of the order of 50 range units.

The following table gives information about the size and coverage of the Ulysses SCE ranging data set from the two solar conjunctions:

Conj	Year	start mo:dd:hh:mm	stop mo:dd:hh:mm	ascii size (kB)	gzip size (kB)
C1	1991	08:07:01:11	09:05:17:55	88	20
C4	1995	02:23:05:06	03:14:14:06	145	33

SCE Doppler Data Processing

Data files have been generated from the ATDFs which contain the quantities of interest for analysis of the Ulysses downlink frequencies. The data set for the first solar conjunction C1 in 1991 from DOY 218-248 (6 August to 5 September) consists of the following files :

DOP91218.063.gz	DOP91227.012.gz	DOP91235.043.gz	DOP91242.014.gz
DOP91219.043.gz	DOP91227.043.gz	DOP91235.063.gz	DOP91242.043.gz
DOP91219.061.gz	DOP91227.063.gz	DOP91236.014.gz	DOP91243.014.gz
DOP91220.043.gz	DOP91228.014.gz	DOP91236.043.gz	DOP91243.063.gz
DOP91221.014.gz	DOP91228.063.gz	DOP91237.014.gz	DOP91244.014.gz
DOP91221.043.gz	DOP91229.014.gz	DOP91237.063.gz	DOP91244.063.gz
DOP91221.143.gz	DOP91229.043.gz	DOP91238.014.gz	DOP91245.014.gz
DOP91222.014.gz	DOP91229.063.gz	DOP91238.043.gz	DOP91245.063.gz
DOP91222.043.gz	DOP91230.014.gz	DOP91238.063.gz	DOP91246.014.gz
DOP91223.014.gz	DOP91230.063.gz	DOP91239.014.gz	DOP91246.043.gz
DOP91223.043.gz	DOP91231.014.gz	DOP91239.043.gz	DOP91247.014.gz
DOP91224.014.gz	DOP91231.063.gz	DOP91239.063.gz	DOP91248.014.gz
DOP91224.063.gz	DOP91232.014.gz	DOP91240.014.gz	DOP91248.043.gz
DOP91225.014.gz	DOP91233.014.gz	DOP91240.063.gz	datalist.c1
DOP91225.063.gz	DOP91234.014.gz	DOP91241.012.gz	
DOP91226.014.gz	DOP91234.043.gz	DOP91241.043.gz	
DOP91226.063.gz	DOP91234.063.gz	DOP91241.063.gz	

The data set for the fourth solar conjunction C4 in 1995 from DOY 53-73 (22 February to 14 March) consists of the following files :

DOP95053.042.gz	DOP95057.042.gz	DOP95063.042.gz	DOP95069.012.gz
DOP95054.012.gz	DOP95057.061.gz	DOP95063.061.gz	DOP95069.042.gz
DOP95054.061.gz	DOP95057.142.gz	DOP95064.061.gz	DOP95069.061.gz
DOP95054.161.gz	DOP95057.161.gz	DOP95065.042.gz	DOP95070.042.gz
DOP95055.042.gz	DOP95058.061.gz	DOP95065.061.gz	DOP95070.061.gz
DOP95055.061.gz	DOP95059.042.gz	DOP95065.142.gz	DOP95071.012.gz
DOP95055.142.gz	DOP95059.061.gz	DOP95066.042.gz	DOP95071.042.gz
DOP95055.161.gz	DOP95060.042.gz	DOP95066.061.gz	DOP95071.061.gz
DOP95056.012.gz	DOP95060.061.gz	DOP95067.012.gz	DOP95072.042.gz
DOP95056.042.gz	DOP95061.012.gz	DOP95067.042.gz	DOP95072.061.gz
DOP95056.061.gz	DOP95061.042.gz	DOP95067.061.gz	DOP95073.042.gz
DOP95056.161.gz	DOP95062.042.gz	DOP95068.012.gz	DOP95073.061.gz
DOP95057.012.gz	DOP95062.061.gz	DOP95068.042.gz	datalist_c4.txt

The "gz" suffix means that these files have been compressed with the UNIX gzip utility. They can be expanded to ascii tables with the analog gunzip utility. Each file contains dual-frequency Doppler data at a sample rate of 1 point per second from each tracking pass. The filename provides the day-of-year (doy) and ground tracking station (dss) according to the scheme "DOPyydoy.dss", where the year number is yy = 91 (C1) or 95 (C4). The doy given to each file applies to the start of the data recording. The deep space stations of the NASA Deep Space Network (DSN) used for SCE are:

DSS 12 : Goldstone	34-m
DSS 14 : Goldstone	70-m
DSS 42 : Canberra	34-m
DSS 43 : Canberra	70-m
DSS 61 : Madrid	34-m
DSS 63 : Madrid	70-m

Some tracking passes, especially at the Canberra stations, continue on into the next doy. Normally, a "0" precedes the dss number. The few cases with a "1" rather than "0" are a separate tracking pass at the same dss later on the same doy. The files "datalist_c1.txt" and "datalist_c4.txt" contain listings of each tracking pass with such information as date, ATDF number, start and end times of pass, start and end times of data recording, pass duration, station overlaps, etc.

Each file contains 15 columns per data point defined as follows:

column	explanation
1-4	time tag (UT, ground received)
1	DOY in 1991 (C1) or 1995 (C4)
2	HH
3	MM
4	SS
5	DSS
6	uplink frequency [Hz]
7-10	S-band receiver parameters
7	agc [dBm]
8	downlink frequency [Hz]
9	downlink frequency residual [Hz]
10	total slipped cycles during count
11-14	X-band receiver parameters
11	agc [dBm]
12	downlink frequency [Hz]
13	downlink frequency residual [Hz]
14	total slipped cycles during count
15	differential Doppler from Counts

A more detailed explanation of the parameters is given in section CRK-2-15 of the JPL Document 820-13 [DSN820-13].

The total volume of validated SCE Doppler data in the archive is given for both conjunctions in the following table.

conjunction	# passes	# hours total	# hours overlap	total MB (ASCII)	total MB (binary compressed)
C1					
ingress	30	169.4	12.2	74.0	14.9
egress	34	201.0	14.4	87.8	17.5
total	64	370.4	26.6	161.8	32.4
C4					
ingress	27	188.2	5.1	73.8	14.8
egress	24	194.0	7.5	76.0	15.2
total	51	382.2	12.6	149.8	30.0
C1+C4	115	752.6	39.2	311.6	62.4

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Ulysses Dual-frequency Doppler Data
 Superior Conjunction C4
 22 February 1995 (DOY 53) --- 14 March 1995 (DOY 73)

No	DOY	Date	ATDF	DSS	File	Pass	Data	Data	Pass	Total	Comments
			No	DOP95..	Start	Start	Start	Stop	Stop	Hours	
1	53	F22	102	42	053.042	20:00	20:39	08:55*	08:57*	12.93	
2	54	F23	102	61	054.061	08:03	08:24	10:09	10:11	01.75	0.53 olap
3	54	f23	103	61	054.161	12:31	13:02	17:12	17:14	04.17	
4	54	F23	103	12	054.012	14:35	19:26	20:30	20:30	01.07	
5	55	F23	104	42	055.042	22:17#	01:20	08:46	08:48	07.43	
6	55	F24	104	61	055.061	07:02	08:10	11:23	11:23	03.22	0.60 olap
7	55	F24	104	61	055.161	14:09	14:09	17:12	17:14	03.05	
8	55	F24	105	42	055.142	18:17	18:44	08:51*	08:52*	14.13	
9	56	F25	105/6	61	056.061	08:05	08:05	12:16	12:16	04.18	0.77 olap
10	56	F25	106	61	056.161	15:20	15:20	17:12	17:15	01.87	
11	56	F25	106	12	056.012	16:37	17:35	20:35	20:35	03.00	
12	56	F25	106/7	42	056.042	18:21	20:28	00:53*	00:53*	04.58	0.12 olap
13	57	F26	108	42	057.042	01:00	01:00	08:30	08:32	07.50	
14	57	F26	108	61	057.061	07:57	07:59	13:11	13:11	05.20	0.52 olap
15	57	F26	108	61	057.161	16:21	16:21	17:11	17:14	00.83	
16	57	F26	108/9	12	057.012	17:20	17:20	20:31	20:31	03.18	
17	57	F26	109/10	42	057.142	18:09	20:26	08:30*	08:31*	12.07	0.08 olap
18	58	F27	110	61	058.061	07:54	07:54	17:08	17:10	09.23	0.60 olap
19	59	F28	111	61	059.061	07:36	08:51	17:06	17:09	08.30	
20	59	F28	111/01	42	059.042	18:53	20:26	08:27*	08:27*	12.02	
21	60	M01	201/02	61	060.061	07:49	07:49	17:08	17:11	08.32	0.63 olap
22	60	M01	202	42	060.042	19:16	20:28	08:21*	08:32*	11.95	
23	61	M02	203	12	061.012	15:13	15:13	20:47	20:47	05.57	
24	61	M02	203/04	42	061.042	19:16	20:22	08:17*	08:18*	11.92	
25	62	M03	204/05	61	062.061	05:36	07:44	17:06	17:10	09.37	0.55 olap
26	62	M03	205	42	062.042	18:56	20:25	08:16*	08:17*	11.87	
27	63	M04	205/06	61	063.061	05:42	07:34	17:05	17:08	09.52	0.70 olap
								subtotals:		188.23	5.10 (10)

***** Conjunction C4 *****

28	63	M04	206/07	42	063.042	19:02	20:25	08:11*	08:11*	11.77	
29	64	M05	207	61	064.061	05:38	07:26	17:03	17:05	09.62	0.75 olap
30	65	M06	208	42	065.042	04:27	06:33	08:07	08:08	01.57	
31	65	M06	208/09	61	065.061	05:21	07:17	17:04	17:05	09.78	0.83 olap
32	65	M06	209/10	42	065.042	20:34	22:59	08:00*	08:02*	09.02	
33	66	M07	210	61	066.061	06:59	07:19	17:02	17:04	09.72	0.68 olap
34	66	M07	210/01	42	066.042	17:38	20:25	07:57*	07:57*	11.53	
35	67	M08	301	61	067.061	06:35	07:10	16:30	17:10	09.33	0.78 olap
36	67	M08	302	12	067.012	15:36	16:33	19:01	19:03	02.47	
37	67	M08	302/03	42	067.042	19:54	20:18	07:53*	07:54*	11.58	
38	68	M09	303	12	068.012	12:38	13:21	21:01	21:01	07.67	
39	68	M09	303/04	42	068.042	19:15	20:15	07:46*	07:47*	11.52	0.77 olap
40	69	M10	304/05	61	069.061	07:10	07:12	17:00	17:06	09.80	0.57 olap
41	69	M10	305	12	069.012	14:37	15:44	20:36	20:36	04.87	1.28 olap
42	69	M10	305/06	42	069.042	20:20	20:20	07:45*	07:47*	11.42	0.27 olap
43	70	M11	306	61	070.061	06:40	07:17	16:57	16:57	09.67	0.47 olap
44	70	M11	306/07	42	070.042	19:46	20:17	06:56*	06:56*	10.65	
45	71	M12	308	61	071.061	14:00	14:00	16:57	17:03	02.95	
46	71	M12	308	12	071.012	18:25	19:27	20:41	20:41	01.23	
47	71	M12	308	42	071.042	18:12	20:28	07:27*	07:27*	10.98	0.22 olap
48	72	M13	308/09	61	072.061	06:25	06:43	16:58	17:00	10.25	0.73 olap
49	72	M13	309	42	072.042	19:27	20:12	22:51	22:51	02.65	

50 73 M14 310 42 073.042 00:20 00:20 07:20 07:24 07.00
51 73 M14 310 61 073.061 04:55 07:10 14:08 14:08 06.97 0.17 olap
= previous day; * = next day 51 pass (22 olap) total: 382.15 12.62

Directory MKB500: []

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Total of 52 files.